EA535055 DTS 15.247 (composite filing with EA168549 NII 15.407)

Inasmuch as MIMO represents a new technology where the procedure for measuring such devices has not been defined, the application was set-aside and re-filed with the FCC Lab. The Lab has in turn reviewed the data for both parts of the application for the composite MIMO device. In reviewing the data for the subject device, we found a number of deficiencies with the information submitted with the application for certification of this composite device. From a test methodology stand-point, the main concerns of FCC are the lack of adequate descriptions of the diversity and coding mechanisms and the lack of sufficient test data for all the different transmit modes to allow us to evaluate and ensure compatibility with the Rules.

The following is a more detailed list of the deficiencies for the subject device. A separate list is also provided the NII portion of the composite device.

1. For the MIMO operation, please indicate whether the signals have fixed phase relationship (i.e., same signal), or if beam-forming is used. Please verify that the current system does not use any beam-forming enhancements. If beam-forming is used, the antenna gain in dBi must include an additional array gain of 10 log (N), where N is the number of antennas. If the phase relationship between the signals is independently varying, an additional array gain is not necessary.

Reply: The Airgo True MIMO radio technology does not utilize any beam forming techniques. The two signals are uncorrelated, therefore, the phase relationship is independently varying .

2. The device contains two transmitting antennas for each transmitter. Indicate whether each transmitter can operate with either one of the antennas alone as well as with both antennas simultaneously. If both modes are possible (e.g., transmission at 2.4 GHz with single or dual signals) both modes have to be tested. Please clarify whether these modes were investigated for all tests: line conducted, conducted spurious, radiated emissions in restricted band, etc.

Reply: No. In all modes both transmit chains are simultaneously operating.

3. Please describe how EMC report and test data accounts for all modulations (BPSK, CCK, OFDM, etc) and data rates. Please include data rate, modulation, EEPROM power settings info for reported data. In general channel power plots (measured with correct BW) should be a good indicator of averaged conducted power (for RF exposure and other purposes); however in the results submitted, in many cases the channel power and power meter data do not match - please clarify. In some plots the peak power levels also do not match, and in some cases channel power has been incorrectly labeled as peak power. Clear indication should be given why some bands are tested at one data rate and other bands are tested at

different data rate (typically highest data rate tends to give the worst spurs and low data rate tends to give the higher average power). Please also identify the modulation used for all available data rates and data modes (turbo, half and quarter etc.), because power may change! e among these rates and modes.

Reply: For 802.11b modulation (DBPSK, DQPSK, CCK) rates of 1,2,5.5, and 11 Mbps were investigated for occupied band width, output power, spurious, and band edge emissions. Output power , occupied bandwidth and spurious emissions did not vary significantly with data rate. Worst case band edge emissions data was determined to be for 11 Mbps. and was chosen for test.

For 802.11g modulation (OFDM), data rates of 6, 54, and 108 Mbps were investigated for occupied band band width, output power, spurious, and band edge emissions. Output power , occupied bandwidth and spurious emissions did not vary significantly with data rate. Worst case band edge emissions appeared to be for 6 Mbps and was chosen for test.

Guidelines associated with 15.247 specify that peak power measurements may be made using a peak power meter that has a video bandwidth greater than or equal to the RF EBW of the signal, or with a spectrum analyzer that has an integrated power measurement function {channel power). Both of these procedures yield a measurement of peak power. CCS used the channel power method.

4. Please provide any appropriate description of diversity and coding mechanisms (e.g. spatial multiplexing or time-space code multiplexing) which may have impacted on the selection of test sequence and procedures.

Reply: Spatial multiplexing is used in the "Airgo True MIMO" modes. More specifically, the data stream is formed identical to a standard 802.11g (802.11a if appropriate band) OFDM waveform but is interleaved across antennas to produce two independent output streams. There is no space-time or space-frequency coding used nor is there any TX beamforming weights applied. In legacy modes, cyclic delay diversity is used on top of the normal 802.11b/g (802.11a if appropriate band). The resulting patterns for both MIMO and TX diversity are OMNI when measured across the 16MHz bandwidth.
(Detailed explanations are contained in section "802.11 Delay Transmit Diversity" of "MIMO regulatory consideration". This document has been uploaded to the FCC website. Confidentiality request is made on this document).

5 Please provide co-transmission data for applicable 2.4 and 5 GHz co-transmission modes. This includes data for all appropriate single-transmitter tests, and co-transmission modes as follows: submit antenna conducted measurements with both transmitters on, if transmitters share an antenna. For radiated emissions, if data for simultaneous transmission is no worse (no new intermod, spurs or increased levels) compared to single-mode tests, then also submit statement that simultaneous transmission was investigated and no new emissions were found. If

new emissions were found during simultaneous tests, provide data and indicate the worst case conditions.

Reply: (Question a): submit antenna conducted measurements with both transmitters on, if transmitters share an antenna.

(Answer to a) The transmitters do not share antennas.

(Question b): For co-transmission radiated emissions

(Answer to b) Simultaneous transmission was investigated and no new emissions were found.

6. Emission Bandwidth
- Indicate whether the results in Section 7.2 of the test report are for single or dual signals.
- Provide worst case data.

Reply: Results are for dual signals (both chains with combiner).
EBW did not vary significantly with different data rates.

7. Output power
- The test procedure in Section 7.3 of the test report does not indicate whether the results are for single or dual transmission modes. This appears to be single transmission mode.
- Provide an output power summary table only for the peak output power measurements made for this DTS filing. Do not mix in the UNII measurements. Ensure that enough channel measurements are made per 15.31(m). Provide the worst case data.
- For the dual transmission mode, a combiner and extra cables were used. Indicate whether the losses due to the combiner and cables were taken into account for dual transmission mode measurements.
- The grant of authorization should reflect the highest (dual transmission mode) levels.

Reply:
- Results are for dual signals (both chains with combiner).
- Power summary table for 15.247 DTS emissions is presented as a separate document uploaded to the FCC website entitled “DTS Power Output.doc”.

- Yes. Separate document summarizes losses due to the combiner and cables.
- Understood.

8. Peak power spectral density
- The test procedure in Section 7.6 of the test report does not indicate whether the results are for single or dual transmission modes. This appears to be single transmission mode. Provide dual transmission mode data. Provide the worst case data.

- For the dual transmission mode, a combiner and extra cables should be used. Indicate whether the losses due to the combiner and cables were taken into account.

Reply:
- Results are for dual signals (both chains with combiner). PPSD did not vary significantly with different data rates.
- Yes. Separate document summarizes losses due to the combiner and cables. This document has been uploaded to the FCC website (Combiner specs.doc).

9. The output amplifier indicates output may vary by 5 dB or more across channels within a band and also across bands - therefore high, middle, low channel tests only may not be appropriate. If possible please extract and report in table or text version the output power parameters from the EEPROM (or settings that were input to the EEPROM) to identify how power fluctuates among channels and frequencies for different data modes and data rates etc.

Reply:
Refer to attached document chanratepwr.xls. The maximum output powers vary according to data rate for a given channel, and for different bands. Ratings reported in data sheet titled 1200 AP VKK are applicable to the EUT, reported numbers are average power readings.

10. Some of the 802.11a plots seem to indicate problems - it appears that some sub-carriers were turned off or there was some sort of duty factor or other problems relating to the data pattern used. Please clarify and/or revise.

Reply: The version of test software used to generate test traffic was unable to produce signals that were not compliant to the 802.11 a/b/g medium access protocols. More specifically, all the interframe spacings and CS-CMA back-off windows that are associated with each packet transmission, were observed in generating this traffic. This introduced "dead" periods in the transmitted waveforms that do not scale with data rate. Furthermore, the packet lengths used were fixed at 2000 bytes. Thus, all output traffic will have a duty cycle that is less than 100% and as the underlying link data rate is increased, the perceived duty cycle would actually decrease (the same 2000 bytes are sent in a shorter period of time for a higher data rate which impliess that the "dead" periods occur more often and the duty cycle decreases).

11. There appear to be errors and inconsistencies in several of the duty factor plots, e.g., wrong duration was used with respect to pulse separation - please clarify and/or revise.

Reply: Corrections were made to all three duty cycle calculations:

1 Mbps: 98.87%
6 Mbps: 97.3%
108 Mbps: 96.6%

12. EMC report sect. 7.4 has MPE estimation for single transmitter mode - please revise or submit separate 15.247(b)(5) MPE exhibit to account for co-transmit mode(s) also. Note that MPE exhibit used in related filing EA168549 has an error in the power density equation shown, and it appears that the rest of that exhibit is incorrect.

Reply: The co-transmit MPE exhibit in filing EA168549 is applicable to both reports and has been uploaded to the FCC website. The formula and the spreadsheet were corrected (E/3770 changed to $E^2/3770$) and results re-calculated. Refer to uploaded documents "1200 AP MPE.doc" and "AP1200 MPE calc.xls".

The following comments identify some further deficiencies in the application not directly related to the measurement issues.

13. The manual indicates that a country code can be selected. Section 15.15 does not allow the user to select unauthorized frequencies or also output powers. Please explain/correct.

Reply:

Due to restrictions prohibiting end-user selection of frequency and transmit power by some Regulatory Agencies, APs will be programmed with ISO Country Codes appropriate to the countries governed by these Regulatory Agencies. Currently, the MPHPT in Japan and the FCC in the United States have regulations requiring that products producing radio waves in the 2.4 and 5 GHz bands adhere to frequency (channel) and transmit power requirements and prohibit end-user selection of alternative frequencies (channels) and transmit power. For products operating in these countries, the World Mode-Country Code cannot be changed**.**

14. Access point (AP) itself has 6 antennas, but the operational description and block diagram shows only 3 antennas. Please clarify the description of the complete device.

Reply. The block diagram only shows one radio, the AP houses 2 radios.

15. User manual Fig 3, Table 9, Fig 70, etc. refers to AP with one radio - please confirm this FCC ID will always include two identical PCMCIA cards; if not please submit other appropriate FCC ID labeling options, external photos, etc.

Reply: Confirmed. The single radio AP will have its own FCC identifier.

16. FYI EMC report pg 4 of 113 states 5 antennas - it is noted there are 6 antennas.

Reply: Thank you. This is a typo, 6 antennas is correct.

17. The internal photos have three PCMCIA slots. Verify that only two PCMCIA transmitters will be used at a time, or revise filing accordingly.

Reply: Only two transmitters will be used at a time. The third slot is provided for future upgrade to include a VPN security module not available for initial product offering.

18. Please submit user manual RF exposure, NII indoor antenna, Part 15, etc. statements.

Reply: The user manual exhibit has been uploaded to the FCC website.

19. The device is also a computer peripheral. Indicate whether the peripheral portion is Class A or Class B. If Class B, it needs to be Certified or DoC approved and the filing corrected accordingly (i.e., additional Certification filing or DoC labeling)

Reply: DoC will be followed.